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COTTON GIN OPERATING AND TESTING EQUIPMENT

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INTRODUCTION

Quality of cotton, insofar as ginning is concerned in the United States, can be improved concurrently with gin operating and maintenance economics, to the advantage of every branch of the cotton industry.

1/ Acknowledgment is made to staff members of the Bureau of Agricultural Engineering and the Bureau of Agricultural Economics for assistance in developing some of the instruments described in this bulletin.

The efficiency with which the crop is now ginned can be materially raised to become mutually beneficial on the one hand to the ginner, through profitable savings, and on the other to the cotton farmer, by providing a better ginning service in every respect.

The use of certain operating and testing equipment at the cotton gin has proved to be of inestimable value and necessary assistance to ginners in obtaining better quality and higher efficiency. Despite these evident advantages, cotton gins in the United States have been, with very few exceptions, noticeably deficient in portable and stationary instruments for indicating operating details of the machinery or the condition of vital elements within individual machines.

A number of commercial instruments available for cotton ginning may be obtained on the open market and have been tested by many years of service in other industries. Several special testing instruments have been developed at the U. S. Cotton Ginning Laboratories in an effort to meet the requirements of gin operators, cotton ginning specialists and appraisers. It is the purpose of this article to acquaint these individuals with the commercial and special instruments which the Department of Agriculture advocates for use in every cotton gin.

PRESSURE INSTRUMENTS

Gages for Steam and Hydraulic Pressures

Pressure gages for steam equipment are in common use in cotton gins and require little comment, but hydraulic gages are seldom found in any gins for indicating the pressures that are being exerted when a bale is pressed. It is frequently desirable for the ginner to be able to watch the pressure fluctuations, and simple gages are now obtainable on the open market for such purposes. A typical hydraulic gage for use on cotton gin presses is shown as "A" in figure 1.

Water Gages for Low Pressures

The observation of the low pressures that are used in lint flues, air-blast nozzles, and other piping requires a different type of gage from those for steam or hydraulic pressure. The low pressure gages suitable for cotton ginning work belong to the class of instruments called "manometers", and give their measurement in inches of water rather than in pounds per square inch. One of the simplest and most reliable forms of low pressure gage or manometer is the simple "U" tube filled with colored water. Another form of manometer that will give a still more accurate reading is the differential manometer which employs a sloping tube. There are also, of course, dial gage low pressure indicators that are used in many industries and such a pressure indicator is shown in "B" of figure 1 along with the manometers previously described.

It would be beneficial for all ginners to know the pressures in their lint flues, and this can be accomplished with a gage delineated as "C" in figure 1. For brush gins the desirable lint flue pressure is generally not more than 1/2 inch of water; and for air-blast gins it does not exceed 3/4 inch.

Air-blast Gages

Air-blast pressure gages are also very convenient in the operation of air-blast gins. The Government design of air-blast gage for stationary use is shown as "A" in figure 2. The manometer for this equipment may be located in any convenient position, the preferable one being sufficiently close to the operating crank of the fan inlet cone to permit the operator to observe the effect of his adustment. This arrangement affords the ginner a "finger tip control" at all times without the necessity of changing his fan speed. On sunny days with dry cotton, the air-blast pressure may be reduced to the most effective minimum in an effort to economize on power consumption; while it may be increased to the required pressure during damp weather or with wet cottons.

For portable use a somewhat different form of tip is used although the manometer is the same as that employed with the stationary gage.

To use the gage, first see that it is plumb and that the surface of the liquid in both glasses is at the zero line. Then hold the tip of the copper tubing so that it almost touches the nozzle of the air-blast gin, at the point "b" in figure 2,B. The air-blast must blow into this tip in a straight line. Either end of the gin stand may be used in taking the reading, because both ends of any gin stand should give the same reading; and all gin stands in any one battery should read reasonably alike if the air-blast piping is correct.

When the jet of air from the gin nozzle is blowing into the tip of the copper tube, the colored liquid in tube "A" will rise above the zero line while than in tube "B" will fall an equal distance.

The total difference in inches between the two levels is then read upon the inch scale. For instance, if the liquid rises in "A" to a distance of 6½ inches above the zero, and falls in "B" 6½ inches, the nozzle pressure is thirteen inches of water, or the sum of the two readings.

BRUSH BALANCING EQUIPMENT

Approximately 56 percent of all the cotton gins in the United States employed brush gin stands in 1935 2/. The materials used in the construction

2/ Bureau of the Census report, "Cotton Ginning Machinery and Equipment by States, 1935."

of gin brushes, the abuses in operating speeds and settings, and the contacts with foreign matter during ginning together with improper care during both the ginning and idling seasons are potential hazards to the brush. Special care must be exercised in operation, and timely and adequate repairs made in order that excessive wear and tear may be avoided. 3/ It is considered good practice to operate 18-inch diameter gin brushes at approximately 1420 revolutions per minute; 16-inch diameter brushes at 1600 revolutions per minute; and 15-inch diameter brushes at 1700 revolutions per minute. Balancing of gin brushes is, therefore, a necessary procedure for eliminating excessive vibrations and insuring a safe operation at such speeds.

Straight Edge Balancers

Straight edges or knife edges comprise one of the simplest methods for balancing a gin brush statically. This method is shown as "A" in figure 3. After the knife edges have been adequately levelled both individually and with respect to each other the brush shaft is placed on them, care being taken not to disturb the levelling. The brush cylinder is then allowed to turn freely on the knife edges so that by gently rocking back and forth it will come to rest, and the underside will then be the heaviest side of the brush. This oscillation should be repeated several times to verify the place the brush is heaviest and when that has been determined lead weights may be temporarily attached to the opposite side of the cylinder and the procedure repeated until a satisfactory balance has been obtained. This method of balancing requires patience and care, as well as frequent checking of the knife edge levels during the procedure.

Ball-bearing Rigs

Essentially the balancing of the brush cylinder on the ball-bearing rig shown as "B" in figure 3 is no different from the procedure followed with knife edges except that careful levelling is not required. The ball-bearing rig has the added advantage of being portable and is preferred by gins and oil mills where an appreciable number of brush cylinders must be handled each season. The weights that have been added to the cylinder to obtain the proper balance should be securely fastened to the brush by driving a medium sized nail through them and into the wooden part of the brush. The most convenient location for the balancing weights is between the brush sticks and on the side of the wooden discs. Another improved method is to counter-sink the weights into the ends of the brush. Here must be exercised great care when attaching the lead weights in the permanent position so that they will be in the same place that they occupied when the brush was being balanced, in order that the balance of the brush will not be disturbed.

3/ Stedronsky, Victor L., and Johnson, Arvid J.: "Care and Repair of Cotton-Gin Brushes", U. S. Dept. of Agriculture Circular No. 467.

Dynamic Balancers

Factories balance their new brushes dynamically so that they will run as fast as 2,000 revolutions per minute without vibration, but this method is seldom feasible at the average cotton gin not only because a special balancing set-up is required for receiving the brush; but also because special adaptability and training is required on the part of the operator.

INSPECTION GAGES

It has been repeatedly demonstrated in many different industries that quality products and satisfactory performances of machine elements can only be obtained by means of reference gages. The saw teeth, ginning ribs, and air-blast nozzles of cotton gin stands are no exception to this experience.

Gin Saw Gages

The two simplest forms of saw gages are shown as "a" and "b" in "A" of figure 4. Good illumination is required in using either form of gage because very slight difference in the slope or pitch of the leading edge of the tooth may generally affect the subsequent operation of the gin stands. In sharpening gin saws every effort should be made to retain the factory pitch of the tooth and the diameter of the saw. 4/ If, on the one hand the pitch is decreased or on the other the saw diameter is noticeably reduced, the ginning capacity and lint turnout will be materially lessened. Large sized calipers, found in most machine shops, are required in checking the outside diameter of gin saws. If such calipers cannot be used with the gin breast raised, it may be necessary to do the measuring when the saw cylinders have been removed from the frame of the gin stand.

A special saw diameter gage, shown as "c" under "A" in figure 4, is being successfully used in saw repairing shops for checking saw cylinders which have been removed from the gin stands. This gage is constructed from a flat piece of No. 22 gage sheet metal, cut in a crescent form and provided with a fold or socket groove on one horn, and with a scale braced on the other, so that the tip diameter of the saws may be read directly upon the scale when the gage is placed on a saw.

Rib Spacing Gages

The slots between the ginning ribs, through which the gin saws

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4/ Bennett, Charles A., and Gerdes, Francis L.: "Care and Maintenance of Cotton-Gin Saws and Ribs"., U. S. Dept. of Agri. Circular No. 393.

operate, must be uniform and of proper width for improved ginning. The best practice has been deemed to be that which provides saw slot spacings of approximately three saw thicknesses in width or 0.117 inch as an average factory job. If the slot becomes wider than 0.141, then the ribs are badly worn. A simple inspection gage for checking the rib spacings is shown as "B" in figure 4. The smallest shank is 0.117 inch in diameter and represents the standard factory setting of new ribs. The second shank is 0.141 inch in diameter and if it will enter between the ribs, the wear has exceeded the allowable limit and the ribs should be repaired or replaced. 5/ The gage is customarily made from 1/4 inch drill stock 2 inches in overall length and with each shank 1/2 inch long by the gage diameter.

Air-blast Nozzle Gages

It is very important in the efficient operation of air-blast gins to maintain the width of air-blast nozzles at factory standard. Since these nozzles are of metal and may be accidentally stuck by entrance of foreign matter or injured through careless handling during installation or removal of the saw cylinders, it is desirable that the ginner should have a simple gage for maintaining constant width. Another need for such a gage arises when the division plates break loose within the body of the nozzle proper and thus allow the lip to be moved outward when air pressure is applied. Inspection and checking of the width of air-blast nozzles can, therefore, be properly made only when the saw cylinder has been removed from the gin stand and the air-blast fan is operated. Under such conditions, each nozzle may be quickly checked from end to end and all differences in width and their respective causes determined. A straightedge should be used in conjunction with the width gage to verify the linear uniformity of the nozzle as well as its opening. Unless the nozzle is kept straight it would operate upon the saws in a serpentine or wobbly line that would contribute to a variety of difficulties. A simple gage developed for this work is shown as "C" in figure 4. With a device similar to this gage, shown as "D" in figure 4, the nozzle clearance can be measured to see that the nozzle is set properly in relation to the saws.

SPEED DETERMINATION DEVICES

Portable Manual Counters

Many moving elements in cotton gins do not require continuous speed indication, and, therefore, manual counters may be used for intermittent inspection and checking. A watch or timepiece is required for use in connection with the notched dial or barrel-type revolution counters and

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5/ See Bennett, Charles A., and Gerdes, Francis L. Footnote 4.

the speed should be checked for at least one minute, to insure accurate readings. These types of counters, illustrated as "a" and "b" in "A" of figure 5, are cheap and very convenient for gin use. The third type of portable counter, shown as "c" in figure 5, is the direct reading portable tachometer which is much more expensive than the others and is suggested only for large commercial gins.

On the ends of the shafts where speed readings are to be taken with portable instruments, suitable "centers" should be provided so that the spindle of the counter or tachometer may be held against the shaft tightly without wabbling and deflecting.

Stationary Tachometers

It is very desirable for cotton gin operators to keep constantly informed as to the speed of their main shaft and gin saws. This can be cheaply and effectively accomplished by means of stationary tachometers, such as those in "B" of figure 5. The automobile type of speed indicator may be located in the most advantageous position several feet away from the moving part if desired, but the belted tachometer should be reasonably close to the shaft to which it is belted. Either type is very satisfactory, requiring only periodic oiling.

In steam powered cotton gins, it is desirable to have one of these instruments located in the engine room and another so located that the gin stand attendant may readily see it. Where the gin stands are directly connected to each other through the saw shaft, only one speed indicator is usually needed, and it may be placed at the last gin stand.

Although it is desirable for the ginner to know the approximate speed of gin fans, it is seldom necessary to place stationary speed indicators on such equipment because means to be discussed later are available for controlling the operation of the fans without necessity for maintaining them rigidly at a fixed speed.

Methods of Calculating Speeds and Aligning Pulleys and Shafts

It is frequently necessary to change the operating speed of shafting or machinery in cotton gins when any modernization or replacement is involved. The type of drives may be flat-belt, Vee-belt, chain, or other types; but the same rules for speed determination in general will apply to them as to flat belts.

The relative speeds of pulleys, neglecting the belt slippage, is proportional in some simple relationship to their diameters so that it becomes relatively easy to figure speeds by considering only the diameters of the driving and driven pulleys in conjunction with the speed of one of the two shafts involved. Where pulleys are of the same size, belting from one to the other gives the same speed; where the driving pulley is smaller

than the driven pulley, the speed of the driven pulley is reduced below that of the driving pulley in the ratio of the diameter of the driving pulley to that of the driven pulley; but if the driving pulley is larger than the driven pulley, then the speed of the driven pulley is increased in direct relationship to its relative diameter with that of the driving pulley. For Vee-belts, the same general rules apply with the distinction that the pitch diameter of the sheaves must be determined and for gears the pitch diameter must likewise be known.

Simple rules are outlined in table 1 for use in finding any desired diameter or speed of pulleys or gears.

TABLE 1 - Rules for finding pulley diameters and speeds

Desired to find	Given	Rule	Formula
Diameter (D) of driving pulley	Diameter (dp) of driven pulley Speed (sp) of driven pulley	Multiply diameter of driven pulley by its speed and divide by speed of driving pulley	$D = dp \times sp$
Speed (S) of driving pulley	Diameter (dp) of driven pulley Speed (sp) of driven pulley Diameter (D) of driving pulley	Multiply diameter of driven pulley by its speed and divide by diameter of driving pulley	$S = \frac{dp \times sp}{D}$
Diameter (dp) driven pulley	Diameter (D) of driving pulley Speed (S) of driving pulley Speed (sp) of driven pulley	Multiply diameter of driving pulley by its speed and divide by speed of driven pulley	$dp = \frac{D \times S}{sp}$
Speed (sp) of driven pulley	Diameter (D) of driving pulley Speed (S) of driving pulley Diameter (dp) of driven pulley	Multiply diameter of driving pulley by its speed and divide by diameter of driven pulley	$sp = \frac{D \times S}{dp}$

Pulleys for straight drives are readily aligned by using a taut wire or chalk line on the edges of the pulleys so that all four edges of the two pulleys will barely touch the line, as shown in "A" of figure 6. If the face widths of the pulleys are not equal, a flat shim equal to one-half the difference in widths, must be used against the edge of the narrow pulley and the wire aligned against the shim.

The alignment of direct connected gin stands is one of the most important items in first-class erection and operation of ginning machinery. A method, illustrated by the diagram "B" of figure 6, is difficult to excel. It involves a beam of light in connection with disks mounted on the saw shafts and having a hole through which the light is passed. The disks may be of thin metal or wood, and should be turned accurately to fit the bearing. The hole in each disk must, for accuracy, be truly centered and should be not more than 1/32 inch in diameter. When all of the gin stands are lined up so that the beam of light may be seen through the row of disks, the alignment is perfect because the line of light has neither deflection nor sag.

TEMPERATURE AND HUMIDITY INDICATORS

Thermometers

Temperature indicators of various sorts are frequently employed in cotton gins, especially in connection with cotton conditioning equipment. (Figure 7). The most common of these instruments is the ordinary thermometer which may be plain or incased in some sort of protective frame and stem. The plain thermometers are the most common kind now in use with cotton driers and conditioners. The framed or jacketed thermometer with the protected stem may be screwed into various kinds of piping and is a very economical form of thermometer that is satisfactory for use in cotton gins. It should be located so that it may be easily read by the ginner or his assistants. Where this cannot be done, the use of the dial thermometer with the extended tube and stem is desirable. The dial thermometer is also desirable where the light is poor and where the use of the indicating hand will enable the instrument to be read at a greater distance. The stems of all thermometers should be so placed as to avoid being struck by cotton or foreign matter.

Psychrometers

Psychrometers, or instruments used to determine the relative humidity and temperature of the atmosphere, may be either portable or stationary, and are generally used in special tests of cotton conditioners and gin fans. The two most common types of psychrometers are the portable sling psychrometer with wet and dry bulb thermometers (fig. 8,A) and the stationary humidity indicator (fig. 8,B) with recording dial and chart. The sling psychrometer is used in connection with Weather Bureau data given in table 2. The stationary instrument gives a direct reading of the relative humidity and requires only periodic checking. Figure 8,C shows a barometer for determining atmospheric pressure.

Table 2.- Relative humidity in percent
(Pressure = 30 inches)

Air Temp. Dry Bulb: Reading Degrees Fahrenheit	Difference Between Wet and Dry Bulb Thermometers in Degrees Fahrenheit																																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
50	93	87	80	74	67	61	55	49	43	38	32	27	21	16	10	5	0																							
51	94	87	81	75	68	62	56	50	45	39	34	28	23	17	12	7	2																							
52	94	87	81	75	69	63	57	51	46	40	35	29	24	19	14	9	4																							
53	94	87	81	75	69	63	58	52	47	41	36	31	26	20	16	10	6	1																						
54	94	88	82	76	70	64	59	53	48	42	37	32	27	22	17	12	8	3																						
55	94	88	82	76	70	65	59	54	49	43	38	33	28	23	19	14	9	5	0																					
56	94	88	82	76	71	65	60	55	50	44	39	34	30	25	20	16	11	7	2																					
57	94	88	82	77	71	66	61	55	50	45	40	35	31	26	22	17	13	8	4																					
58	94	88	83	77	72	66	61	56	51	46	41	37	32	27	23	18	14	10	6	1																				
59	94	89	83	78	72	67	62	57	52	47	42	38	33	29	24	20	16	11	7	3																				
60	94	89	83	78	73	68	63	58	53	48	43	39	34	30	26	21	17	13	9	5	1																			
61	94	89	84	78	73	68	63	58	54	49	44	40	35	31	27	22	18	14	10	7	3																			
62	94	89	84	79	74	69	64	59	54	50	45	41	36	32	28	24	20	16	12	8	4	1																		
63	95	89	84	79	74	69	64	60	55	50	46	42	37	33	29	25	21	17	13	10	6	2																		
64	95	90	84	79	74	70	65	60	56	51	47	43	38	34	30	26	22	18	15	11	7	4	0																	
65	95	90	85	80	75	70	66	61	56	52	48	44	39	35	31	27	24	20	16	12	9	5	2																	
66	95	90	85	80	75	71	66	61	57	53	48	44	40	36	32	29	25	21	17	14	[illegible]	7	3	0																
67	95	90	85	80	75	71	66	62	58	53	49	45	41	37	33	30	26	22	19	15	12	8	5	2																
68	95	90	85	80	76	71	67	62	58	54	50	46	42	38	34	31	27	23	20	16	13	10	6	3																
69	95	90	85	81	76	72	67	63	59	55	51	47	43	39	35	32	28	24	21	18	14	11	8	5	1															
70	95	90	86	81	77	72	68	64	59	55	51	48	44	40	36	33	29	25	22	19	15	12	9	6	3															
71	95	90	86	81	77	72	68	64	60	56	52	48	45	41	37	33	30	27	23	20	17	13	10	7	4	1														
72	95	91	86	82	77	73	69	65	61	57	53	49	45	42	38	34	31	28	24	21	18	15	12	9	6	3														
73	95	91	86	82	78	73	69	65	61	57	53	50	46	42	39	35	32	29	25	22	19	16	13	10	7	4	1													
74	95	91	86	82	78	74	69	65	61	58	54	50	47	43	39	36	33	29	26	23	20	17	14	11	8	5	3													
75	96	91	86	82	78	74	70	66	62	58	54	51	47	44	40	37	34	30	27	24	21	18	15	12	9	7	4	1												
76	96	91	87	82	78	74	70	66	62	59	55	51	48	44	41	38	34	31	28	25	22	19	16	13	11	8	5	3												
77	96	91	87	83	79	74	71	67	63	59	56	52	48	45	42	39	35	32	29	26	23	20	17	14	12	9	6	4												
78	96	91	87	83	79	75	71	67	63	60	56	53	49	46	43	39	36	33	30	27	24	21	18	16	13	10	8	5												
79	96	91	87	83	79	75	71	[illegible]	64	60	57	53	50	46	43	40	37	34	31	28	25	22	19	17	14	11	9	6												
80	96	91	87	83	79	75	72	[illegible]	[illegible]	61	57	54	50	47	44	41	38	35	32	29	26	23	20	18	15	12	[illegible]	7	5	3	0									
82	96	92	88	84	80	76	72	69	65	61	58	55	51	48	45	42	39	36	33	30	28	25	22	20	17	14	[illegible]	[illegible]	7	5	2	0								
84	96	92	88	84	80	76	73	[illegible]	[illegible]	62	59	56	52	49	46	43	40	37	35	32	29	26	24	21	19	15	[illegible]	[illegible]	9	7	5	3	0							
86	96	92	88	84	81	77	73	70	66	63	60	57	53	50	47	44	42	39	36	33	31	28	26	23	21	18	[illegible]	[illegible]	11	9	7	5	3	1						
88	96	92	88	85	81	77	74	[illegible]	67	64	61	57	54	51	48	46	43	40	37	35	32	30	27	25	22	20	18	16	13	11	9	7	5	3	1					
90	96	92	89	85	81	78	74	71	68	65	61	58	55	52	49	47	44	41	39	36	34	31	29	26	24	22	[illegible]	17	15	13	11	9	7	5	3	1				
92	96	92	89	85	82	78	75	72	68	65	62	59	56	53	50	48	45	42	40	37	35	32	30	28	25	23	[illegible]	[illegible]	17	15	13	11	9	7	5	3	1			
94	96	93	89	85	82	79	75	[illegible]	69	66	63	60	57	54	51	49	46	43	41	38	36	33	31	29	27	24	[illegible]	20	18	16	14	12	10	9	7	5	3	1		
96	96	[illegible]	89	86	82	79	76	[illegible]	69	66	63	61	[illegible]	55	52	50	47	44	42	39	37	35	32	30	28	26	[illegible]	[illegible]	20	18	16	14	12	10	8	7	5	3	2	0
98	96	93	89	86	83	79	76	[illegible]	70	67	64	61	[illegible]	56	53	50	48	45	43	40	38	36	34	32	29	27	[illegible]	[illegible]	21	19	17	15	14	12	10	8	7	5	3	2
100	96	93	89	86	83	80	77	[illegible]	70	68	65	62	59	56	54	51	49	46	44	41	39	37	35	33	30	28	[illegible]	[illegible]	[illegible]	21	19	17	15	13	12	10	8	7	5	4
104	97	93	90	87	83	80	77	[illegible]	71	69	66	63	60	58	55	53	50	48	46	43	41	39	37	35	33	31	[illegible]	[illegible]	25	23	21	20	18	16	14	13	11	10	8	7
108	97	93	90	87	84	81	78	[illegible]	[illegible]	70	67	64	62	59	57	54	52	49	47	45	43	41	39	37	35	33	[illegible]	[illegible]	27	25	24	22	20	19	17	16	14	12	11	10
112	97	94	90	87	84	81	79	[illegible]	[illegible]	70	68	65	63	60	58	55	53	51	49	47	44	42	40	38	36	35	[illegible]	[illegible]	29	27	26	24	23	21	19	18	16	15	14	12
116	97	94	91	88	85	82	79	[illegible]	[illegible]	71	69	66	64	61	59	57	54	52	50	48	46	44	42	40	38	36	[illegible]	[illegible]	31	29	28	26	25	23	22	20	19	17	16	14
120	97	94	91	88	85	82	80	77	[illegible]	72	69	67	65	62	60	58	55	53	51	49	47	45	43	41	40	38	[illegible]	[illegible]	33	31	29	28	26	25	23	22	21	19	18	17
124	97	94	91	88	85	83	80	78	[illegible]	73	70	68	65	63	61	59	57	54	52	50	48	47	45	43	41	39	[illegible]	36	34	33	31	30	28	27	25	24	22	21	20	18
128	97	94	91	89	86	83	81	[illegible]	[illegible]	73	71	68	66	64	62	60	58	56	54	52	50	48	46	44	42	41	[illegible]	37	36	34	33	31	30	28	27	25	24	23	22	20
132	97	94	92	89	86	84	81	79	76	74	71	69	67	65	63	61	58	56	55	53	51	49	47	45	44	42	40	[illegible]	37	36	34	33	31	30	28	27	26	24	23	22
136	97	94	92	89	86	84	81	79	77	74	72	70	68	65	63	61	59	57	55	54	52	50	48	46	45	43	41	40	38	37	35	34	33	31	30	28	27	26	25	23
140	97	95	92	89	87	84	82	79	77	75	73	70	68	66	64	62	60	58	56	54	53	51	49	47	46	44	43	41	40	38	37	35	34	32	31	30	29	27	26	25
144	97	95	92	89	87	84	82	80	78	75	73	71	69	67	65	63	61	59	57	55	53	52	50	48	47	45	44	42	41	39	38	36	35	34	32	31	30	29	27	26
148	97	95	92	90	87	85	82	80	78	76	73	71	69	67	65	63	61	60	58	56	54	53	51	49	48	46	45	43	42	40	39	38	36	35	34	32	31	30	28	28
152	98	95	93	90	88	85	83	81	79	76	74	72	70	68	66	64	62	60	59	57	55	53	52	50	48	47	46	44	42	41	40	39	37	36	35	33	32	31	30	29
156	98	95	93	90	88	85	83	81	79	77	74	72	71	69	67	65	63	61	59	58	56	54	53	51	49	48	46	45	43	42	41	40	38	37	36	34	33	32	31	30
160	98	95	93	90	88	86	83	81	79	77	75	73	71	69	67	65	64	62	60	58	57	55	53	52	50	49	47	46	44	43	42	41	39	38	37	35	34	33	32	31
164	98	95	93	91	88	86	84	82	80	78	75	73	72	70	68	66	64	62	61	59	58	56	54	52	51	49	48	47	45	44	43	41	40	39	38	36	35	34	33	32
168	98	95	93	91	88	86	84	82	80	78	76	74	72	70	68	67	65	63	61	60	58	56	55	53	52	50	49	47	46	45	43	42	41	40	39	37	36	35	34	33
172	98	95	93	91	89	86	84	82	81	78	76	74	73	71	69	67	66	64	62	60	59	57	55	54	53	51	50	48	47	46	45	43	42	41	39	38	37	36	35	34
176	98	96	94	91	89	87	85	83	81	79	77	75	73	71	70	68	66	64	63	61	60	58	56	55	53	52	50	49	48	46	45	44	43	42	40	39	38	37	36	35
180	98	96	94	91	89	87	85	83	81	79	77	75	73	72	70	68	67	65	63	62	60	58	57	55	54	52	51	50	48	47	46	45	43	42	41	40	39	38	36	35

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AIR VOLUME CONTROL APPARATUS

Dampers

It is frequently advantageous to regulate the pressure in air-blast ginning systems without making any changes in the speed of the air-blast fan, and this can be accomplished by the two simple methods delineated in figure 9.

The cone method of control, which was developed at the U. S. Cotton Ginning Laboratories, permits adjustment of the volume of air entering the fan without introducing turbulence or eddies that would disturb the efficiency of the wheel. When the plain slide damper is used, it should be placed sufficiently away from the fan to avoid cavitation or turbulence at the inlet of the fan.

With either of these methods of control, it is desirable to use an air-blast gage similar to that previously shown in figure 2 and place it within plain sight of the control. The fan is operated at its customary speed and the pressure for the air-blast volume may be then adjusted within the range of working limits that have been found by actual practice to be best.

It should be borne in mind that the use of a slide damper will not obtain a proportional reduction in air volume equal to the blanking off of any given portion of the area of the fan intake. That is to say, when a damper is blocking off only 1/2 of the intake pipe, the volume suffers a greater reduction, which is approximately 38% of that obtained through the pipe when fully opened. Table 3 gives the approximate volumes in percentage of total volume that may be expected in a round duct for different positions of a plain damper.

TABLE 3 - Plain damper control of air volumes in fan intake piping

Damper Travel from Closed Position	Approximate Volume Passing Through Damper Opening
Percent	Percent
10	4
20	8
30	15
40	23
50	38
60	53
70	70
80	86
90	97
Full open	100 - or full volume

Other Methods of Air Control

The older types of mechanical separators, many of which are still in use in cotton gins, often possess peculiar characteristics that are associated with small screens or deficient free areas. With them exists the liability of frequent chokage when greater volumes of air are drawn through the screening surfaces than they can handle at normal velocity. To overcome this difficulty, the manufacturers provided counter-weighted control valves at the suction discharge from the separators; each valve being set at the gin so that the amount of suction upon the body of the separator was limited and when reached, caused the valve to be opened and thus permitted air to flow to the fan suction without going through the separator. Such a valve was necessary when a seed blowing system was used, because the heavy feeding of seed cotton at the suction telescope may have at times effectually reduced the quantity of air flowing to the fan. This, in turn, not only built up a greater suction on the fan intake, but so restricted the volume of air for seed blowing that an auxiliary supply had to be introduced between the separator and the fan.

Since few seed blowing installations are economical in their use of power and since the use of an auxiliary valve between the separator and the fan often places a greater power load on the fan when the gin is idling than when operating, the use of seed blowing systems and control valves are open to question. Where no seed blowing or cotton drying installation is involved, a plain "butterfly" valve may be used between the fan and separator to regulate the suction that may be placed upon the body of the separator.

In modernizing old gins and in making layouts for new installations, it is quite feasible to select the piping sizes for the inlet and discharge of fans so that the air volumes will be economically limited and the resulting pressures or velocities provided for without depending upon dampers or other means for achieving a complete control. In other words, where the piping systems are properly designed to serve a special installation, the need for a wide range of control may become very limited, and comprise only the desirable regulation of the air-blast fan.

MISCELLANEOUS INSTRUMENTS

The kind of ginning installation, together with its size and capacity, will influence the use of various instruments for measuring power and improving various aspects of the ginning service. In 1935 there were reported for the United States 6/ 5,779 steam gins; 3,102 Diesel gins; 1,793 natural gas and gasoline engine powered gins; 3,307 electric gins; and 261 water power gins. For such a distribution of power, it is obvious that there is no particular instrument universally suitable for the measurement of energy

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6/ See Bureau of the Census report, Footnote 2.

consumption, and there is none known to be now on the market for use with the water power, nor gas, gasoline or Diesel engines.

Electric Meters

Electrically operated gins are readily suited to the measurement of power consumption, and in addition to their customary service meters may utilize portable meters for determining the performance of individual motors throughout the ginning installation. If no portable electric meters are available for determining the power consumption of different parts of the cotton gin, it is possible in many cases to utilize the main meter of the gin and operate only those machines upon which the power information is desired. Under such conditions the practice is to begin the readings with all elements except the gin stands idle, and then progressively throw on one belt after another for succeeding units that are to be operated until the entire load is on the main motor. Table 4 is very convenient for use in determining the power consumption at cotton gins when the motor is one of those shown on the table.

Steam Engine Indicators and Dynamometers

The measurement of work done by steam engines is usually accomplished by means of engine indicators, and that of Diesel, gas or gasoline engines by dynamometers.

There are several types of indicators on the market such as external and internal spring, high- and low-pressure, high- and low-speed, large and small drum indicators, and so forth. So many features of importance exist in their operation, adjustment and calibration that the reader is referred to special treatises dealing with them. The many uses and functions of engine indicators are such important means of improving the operation and economy of steam driven plants that they should be employed in large volume steam gins.

Unfortunately for the ginning industry there are no dynamometers at present on the market for measuring and indicating the power of Diesel, natural gas or gasoline engines in the cotton gin. There are, however, several types of factory and laboratory testing dynamometers, divided into the two principal classes of absorption and transmission units. The first classification comprises brakes of different kinds, such as prony, hydraulic, electric and others that are used to absorb the power; while the second classification, suitable for development in the ginning industry, transmits the power through the dynamometer by means of traction, gears, belts, torsion or electrical apparatus.

Table 4.– Electric meter readings for power determination at cotton gins. (3-phase Power Meters)

Meter Amps.	Rating Volts	Horsepower constant (HP-K) for 220 volts service 1/ for self contained and instrument transformer type meters				
		Westinghouse Sangamo Duncan	Duncan "M2P" Only	Sangamo "H" Only	General 2/ Electric D-6, D-7 and D-14	General 3/ Electric D-14
300	220	6.44	4.83	4.03	5.79	11.58
250	"	5.36	4.02	3.35	4.83	9.66
200	"	4.28	3.22	2.67	3.86	7.72
150	"	3.22	2.42	2.01	2.89	5.78
125	"	2.68	2.01	1.68	2.41	4.82
100	"	2.14	1.61	1.34	1.83	3.86
80	"	1.71	1.29	1.07	1.54	3.08
75	"	1.61	1.21	1.00	1.45	2.90
50	"	1.07	.80	.67	.97	1.94
25	"	.54	.40	.34	.48	.96

1/ For circuits having 440 volts multiply by 2, and for circuits having 2,200 volts multiply by 10.

2/ Applies to type D-14 instrument transformer type meters only.

3/ Applies to type D-14 self contained type meters only.

The above table is used as follows: Formula: HP-K x RPM = Horsepower in which RPM = Revolutions per minute of the meter disk.

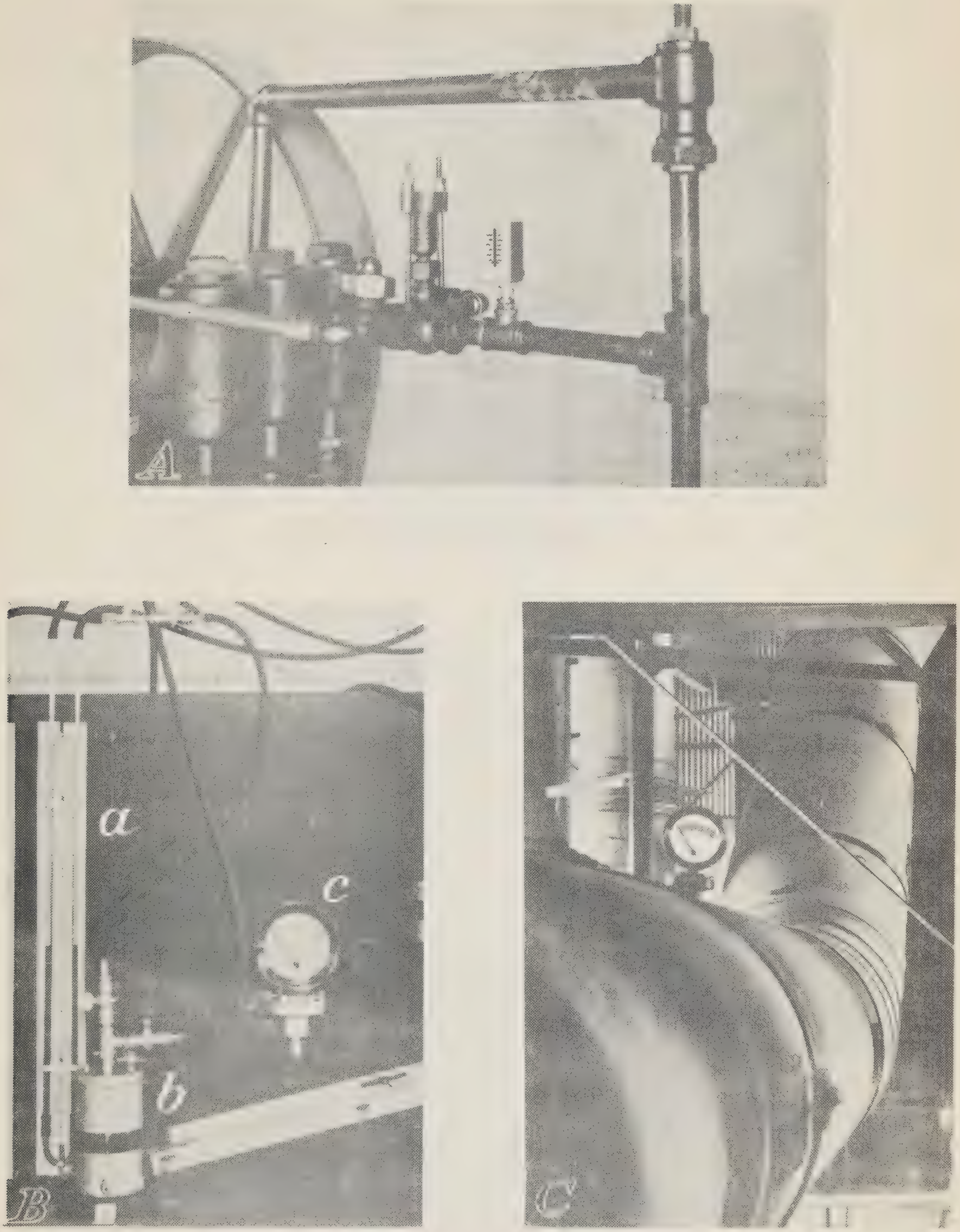

Figure 1. Pressure Instruments. A, Hydraulic gage for cotton gin presses; B, low pressure gages for lint flues, (a) plain "U" tube manometer, (b), differential manometer, and (c), factory-type metallic gage; and C, pressure gage for cotton lint flues.

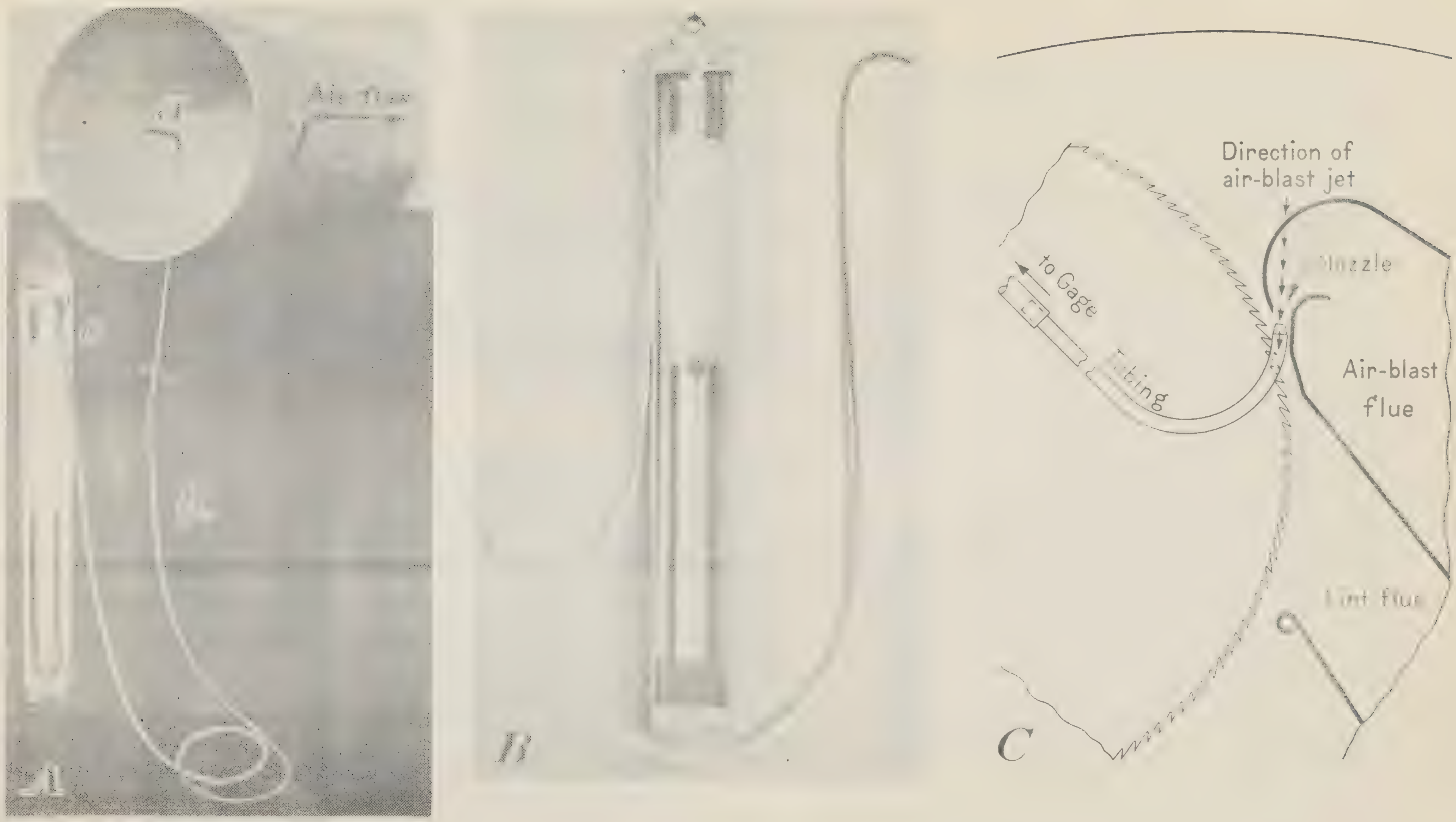

Figure 2. Air-blast gages. A, Stationary, (a), static tip in air-blast pipe, (b), connecting tube between static tip and manometer, and (c), manometer; B, portable manometer, and C, static tip at nozzle for obtaining pressure readings.

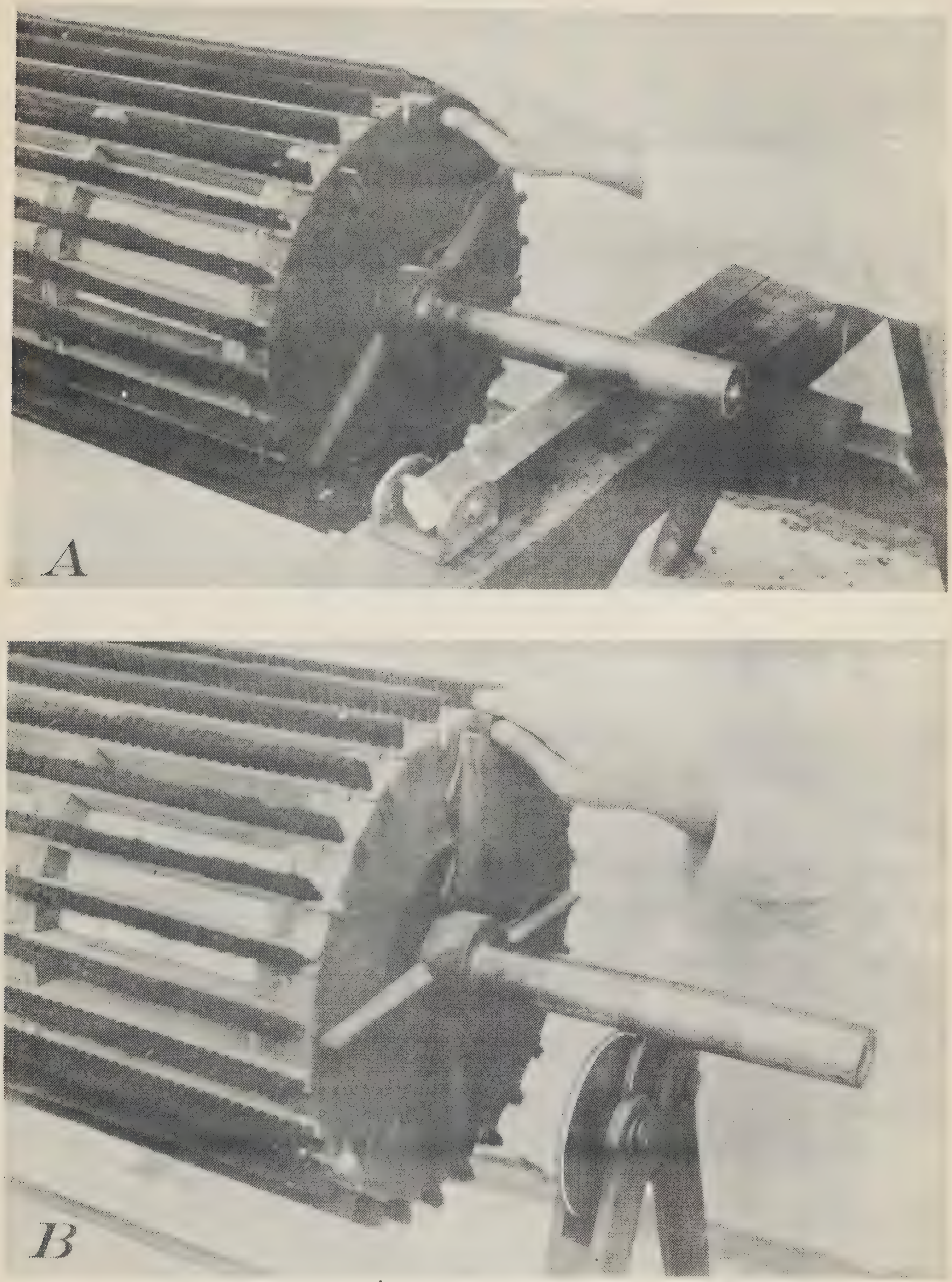

Figure 3. Set-up for balancing gin-brush cylinders.

A, Knife edges; B, ball-bearing rigs.

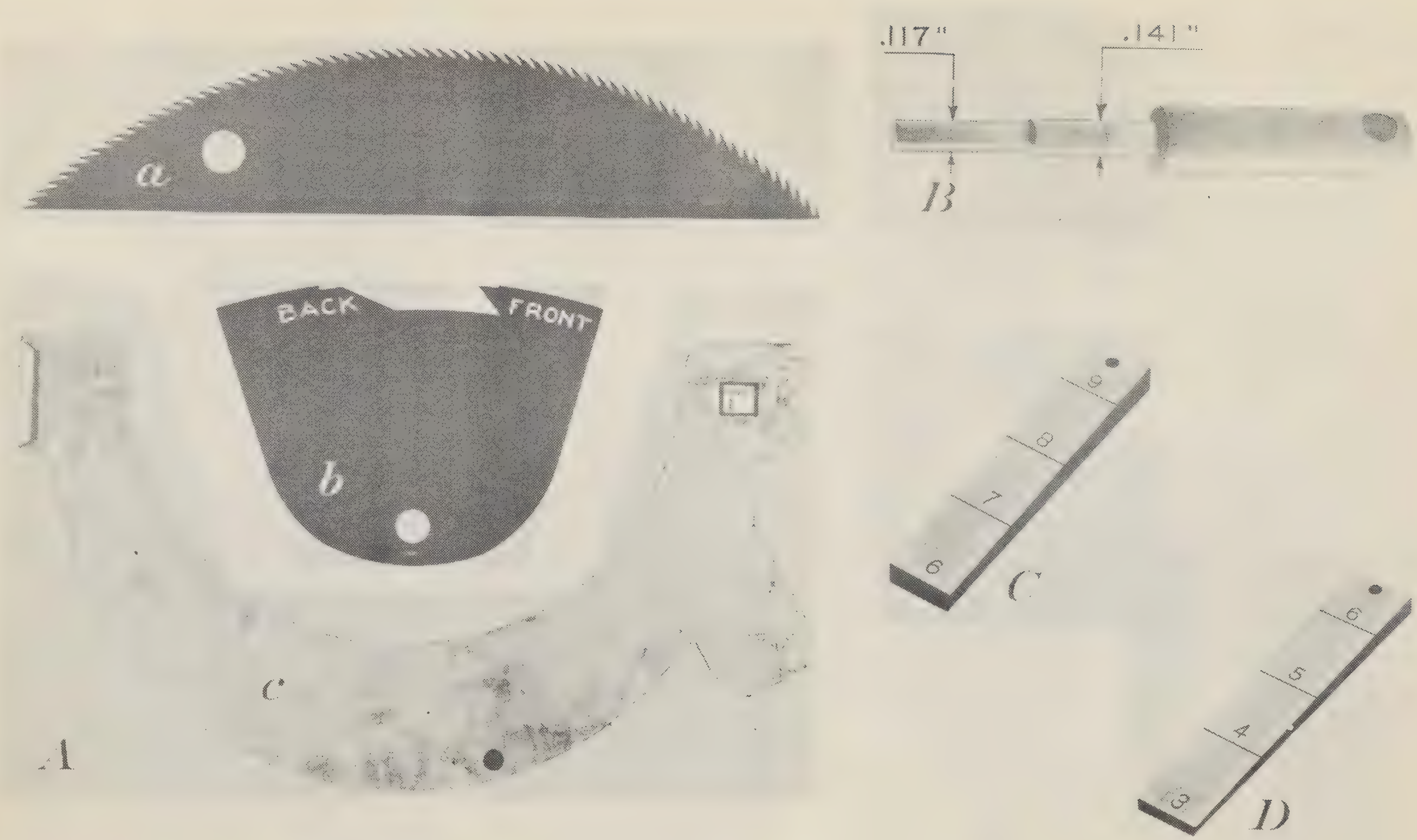

Figure 4. Inspection Gages. A, Gin-saw gages, (a), segment of factory saws, (b), tooth pitch and shape gage, and (c), saw diameter gage; B, rib spacing gage; C, nozzle width gage; and D, nozzle clearance gage. In C and D numerals indicate thicknesses at marks in thirty-seconds of an inch.

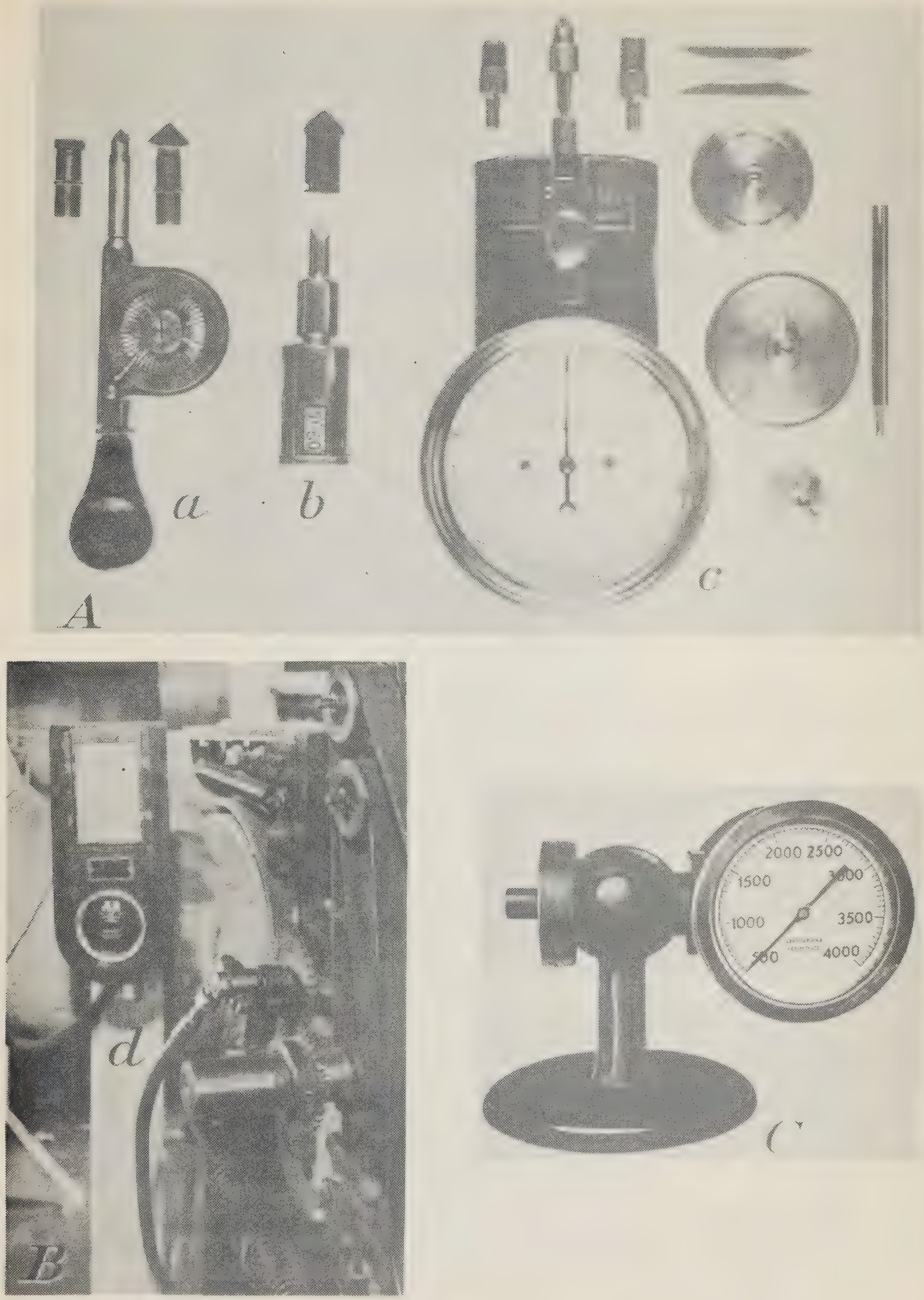

Figure 5. Speed Determination Devices. A, Manual counters, (a), revolution counter with notched dial and interchangeable tips, (b), barrel-type indicator with counter window, and (c), direct reading portable tachometer; B, mechanically operated indicating tachometers, (d), automobile-type speed indicator driven from gears by flexible shaft of chain or wire; C, belt-driven speed indicator.

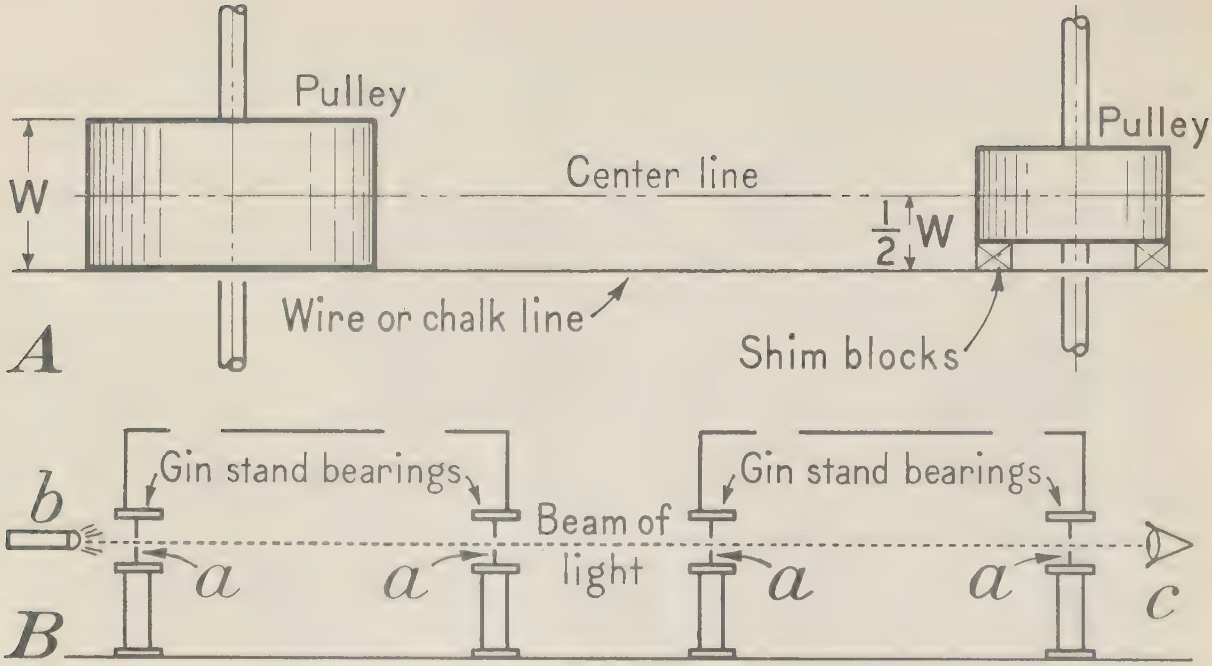

Figure 6. Diagrams of methods of alining pulleys and gin stands. A, Alining pulleys; and B, alining gin stands. a, disks clamped into new shaft bearings; b, the source of light; and c, eye of observer.

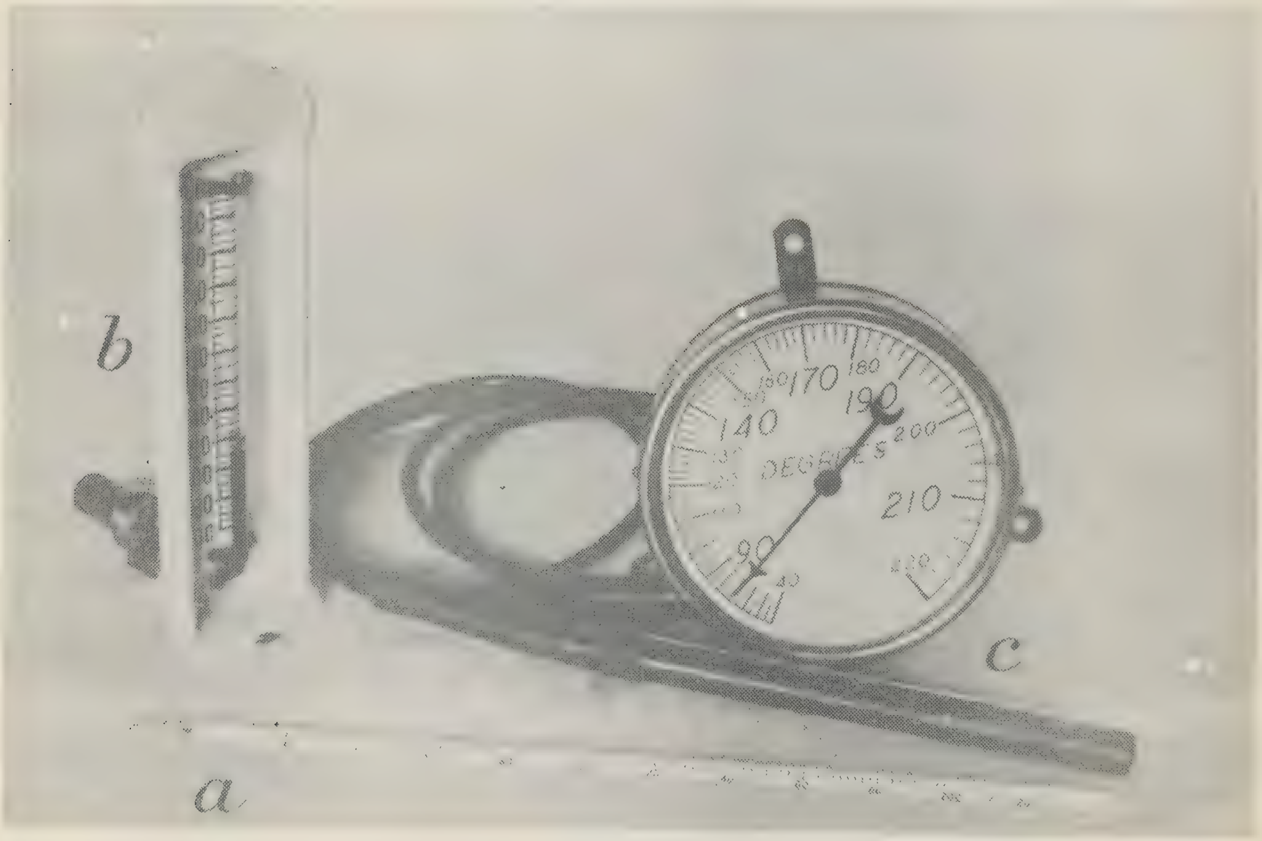

Figure 7. Thermometers. a, plain thermometer; b, thermometer with jacket and protected stem; and c, dial thermometer with extension tube and stem.

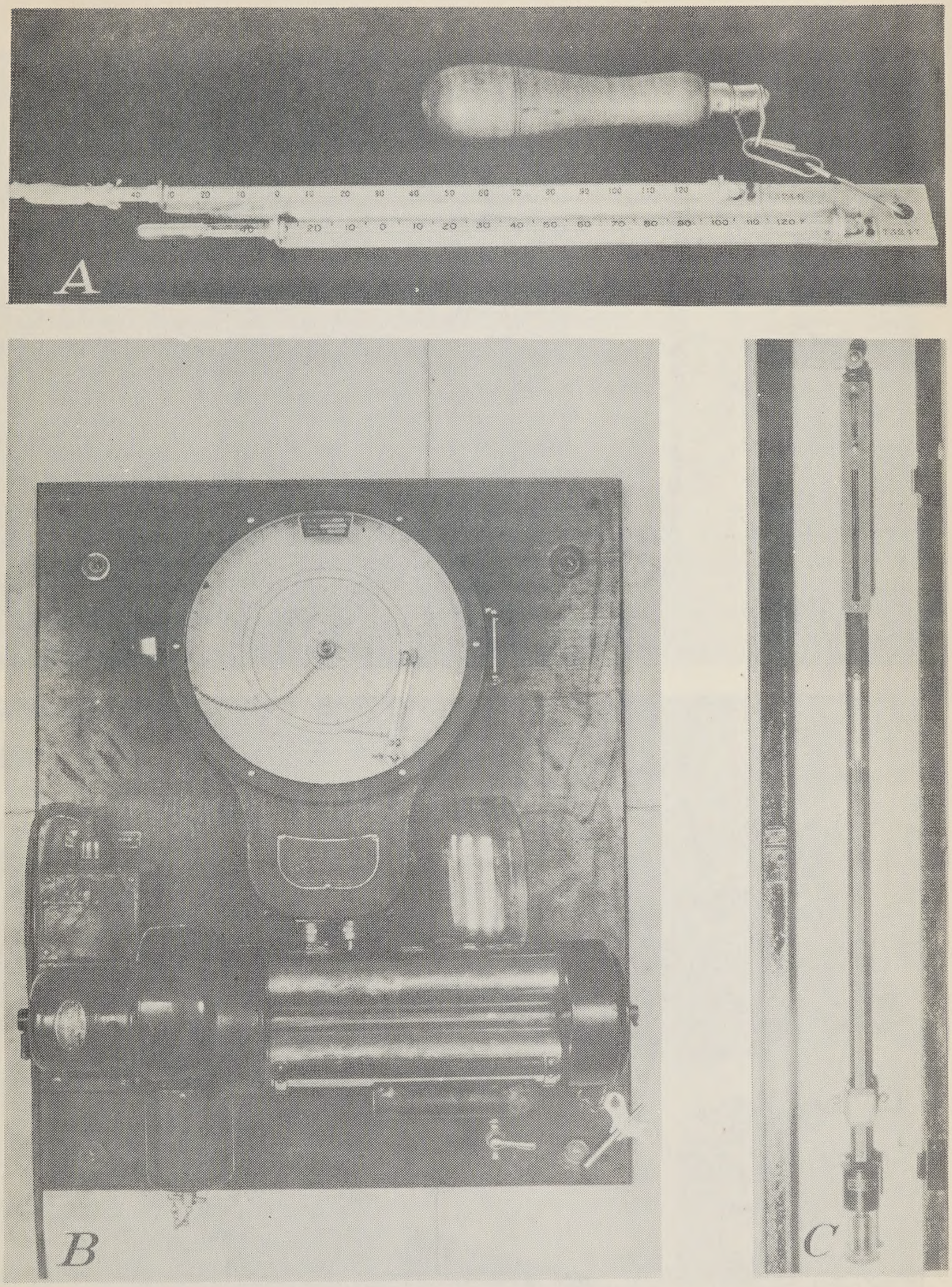

Figure 8. Instruments for determining atmospheric temperature, humidity, and pressure. A, portable sling psychrometer with wet and dry bulb thermometers; B, stationary humidity indicator with recording dial and chart; and C, barometer.

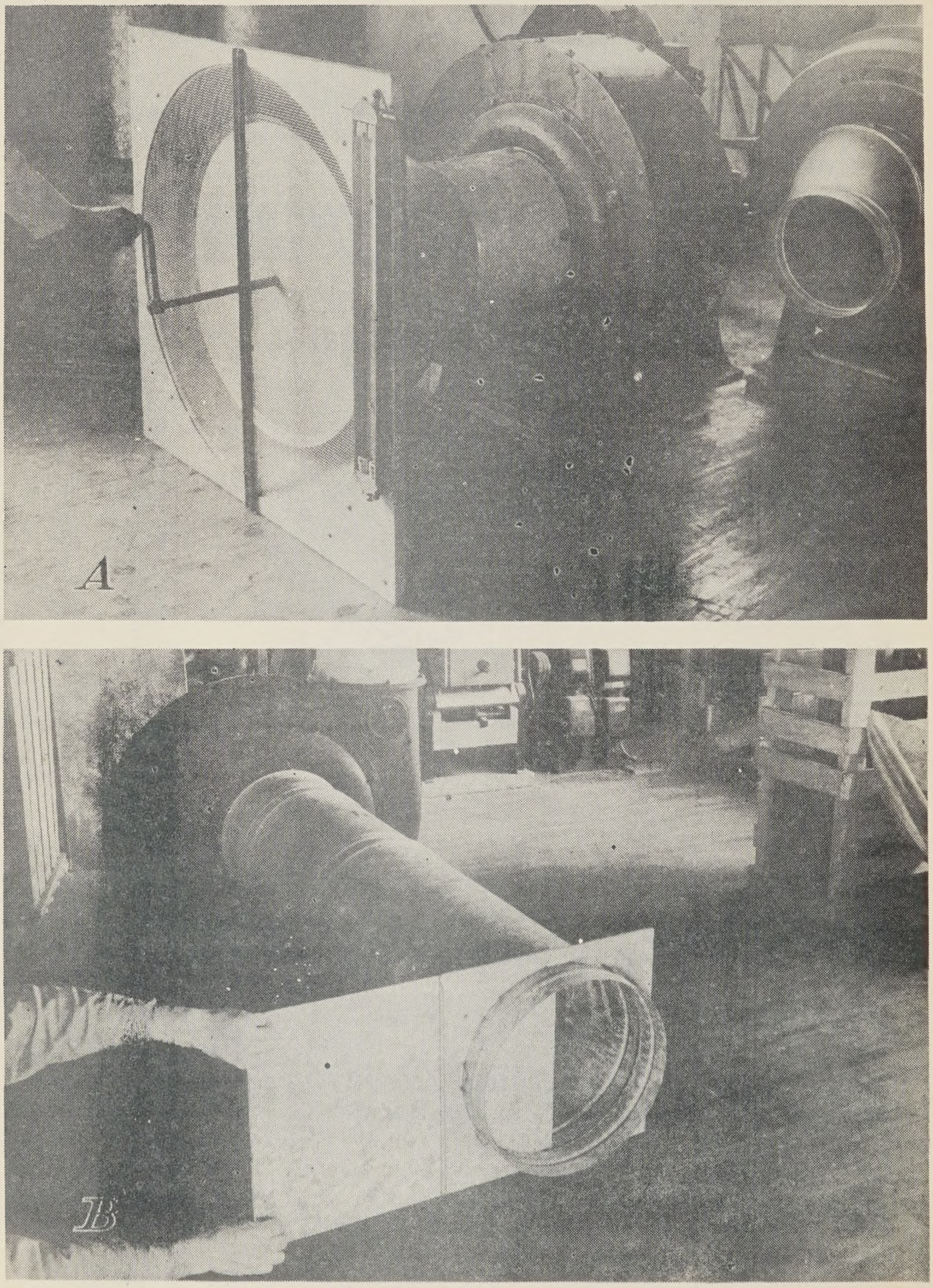

Figure 9.- Volume controls on the intake of air-blast gin fans. A, adjustable cone operated with hand crank; and B, plain slide damper.